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2001-2010: Decade to Roll Back Malaria in Developing Countries, Particularly in Africa

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Note by the Secretary-General

The Secretary-General has the honour to transmit to the General Assembly the report prepared by the World Health Organization pursuant to Assembly resolution 65/273.

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Report of the World Health Organization entitled "Consolidating gains and accelerating efforts to control and eliminate malaria in developing countries, particularly in Africa, by 2015"

Summary

The present report highlights current progress towards meeting the goals concerning malaria control in the context of General Assembly resolution 65/273. It draws on the following recent progress reports: *World Malaria Report 2010* (2010) and Malaria Prevention and Control: Sustaining the Gains and Reducing Transmission (report to the World Health Assembly), produced by the World Health Organization (WHO), and *Saving Lives with Malaria Control: Counting Down to the Millennium Development Goals* (2010) and *Business Investing in Malaria Control: Economic Returns and a Healthy Workforce for Africa* (2011), produced by the Roll Back Malaria Partnership. Data from malaria-endemic countries and other Roll Back Malaria partners, including the Alliance for Malaria Prevention, are also used. The report concludes with recommendations for the consideration of the Assembly.

Over the past decade, malaria control efforts have attracted considerable political attention and financial support at the international, regional and country levels. At the African Summit to Roll Back Malaria, held in Abuja in 2000, African heads of State pledged to "halve the malaria mortality for Africa's people by 2010, through implementing strategies and actions for Roll Back Malaria". World leaders put forth the challenge "have halted by 2015 and begun to reverse the incidence of malaria" as a component of one of the eight Millennium Development Goals. In early 2008, the Secretary-General Ban Ki-moon appointed a Special Envoy for Malaria to mobilize global support for action on the disease. Following the call of the Secretary-General for universal coverage, and in response to a growing international push for a long-term commitment to malaria control, the Roll Back Malaria Partnership collectively developed the Global Malaria Action Plan. The objectives of the plan are to accelerate and sustain malaria control efforts, eliminating the disease where possible, and to ensure investment in research for new tools that would permit the eradication of the disease in the long term.

At its sixty-fifth session, the General Assembly passed a comprehensive resolution entitled "Consolidating gains and accelerating efforts to control and eliminate malaria in developing countries, particularly in Africa, by 2015". In May 2011, the World Health Assembly also passed a resolution on malaria calling on Member States, international partners and the Director-General of WHO to undertake a comprehensive set of actions in order to ensure the achievement of ambitious global targets by 2015.

In June 2011, following a consultative process, revised objectives, targets, and priorities of the Global Malaria Action Plan were released. The primary objective, achieving near zero deaths from malaria by 2015, will require an extraordinary intensification of current efforts. With continued support from the Roll Back Malaria Partnership; the United Nations, including its specialized agencies, such as WHO and the United Nations Children's Fund, as well as the Office of the Special Envoy of the Secretary-General for Malaria; bilateral development partners; and the African

Leaders Malaria Alliance (a group of 39 African heads of State working to end malaria-related deaths and who track progress through a quarterly scorecard); malaria control continues to be a high priority on the global development agenda in 2011, and the accelerated drive to achieve universal coverage with today's tools continues to produce impressive results.

In response to global advocacy efforts, international funding commitments for malaria control have increased from less than $0.2 billion in 2000 to $1.8 billion in 2010, owing largely to the establishment of the Global Fund to Fight AIDS, Tuberculosis and Malaria and major commitments by the United States Government through the President's Malaria Initiative, the World Bank and other agencies. This increase in funding has resulted in a dramatic scale-up of malaria control interventions in many settings and has led to measurable reductions in the malaria burden. However, it appears that new commitments for malaria control have stagnated in 2009 and 2010, at $1.8 billion (approximately 30 per cent of the estimated need). Nevertheless, there have been recent new commitments from the Government of the United Kingdom of Great Britain and Northern Ireland, which has developed a malaria framework for results entitled "Breaking the cycle: saving lives and protecting the future", which was released in late 2010. The Government of the United Kingdom has pledged up to £500 million per year to fight malaria by 2014, an increase from its current annual funding level of £150 million.

Coverage with insecticide-treated mosquito nets continues to increase rapidly in many African countries; by mid-2010, household ownership of at least one insecticide-treated net was estimated to have risen to 42 per cent, as compared with 31 per cent in 2008. Furthermore, more children under 5 years of age used such a net in 2010 (35 per cent) than in previous years. Household ownership of insecticide-treated nets is estimated to have reached more than 50 per cent in 19 high-burden African countries in 2010, an increase from 13 countries in 2009. Despite such successes, the percentage of children using a net is below the World Health Assembly target of 80 per cent, primarily because of low ownership of nets in several large African countries and owing to a lack of sufficient nets for all household members. Resources for further scale-up are being made available; in less than three years, between 2008 and 2010, a cumulative total of 289 million insecticide-treated nets had been delivered to sub-Saharan Africa, enough to cover 76 per cent of the 765 million persons at risk.

The procurement of rapid diagnostic tests and artemisinin-based combination therapies for malaria continues to increase. The percentage of reported suspected cases receiving a parasitological test has increased globally from 67 per cent in 2005 to 73 per cent in 2009. By the end of 2009, 11 African countries were providing sufficient courses of artemisinin-based combination therapies to cover more than 100 per cent of malaria cases seen in the public sector; a further 8 African countries delivered sufficient courses to treat 50-100 per cent of cases. These figures show a substantial increase since 2005. However, evidence does indicate that many patients are still receiving artemisinin-based combination therapies without confirmatory diagnosis.

In high-burden African countries that have achieved high coverage of their populations with insecticide-treated nets and treatment programmes, recorded cases and deaths due to malaria have fallen by 50 per cent, suggesting that the targets for Millennium Development Goal 6, of reversing the incidence of malaria, can be

achieved if there is adequate coverage with key interventions. These results were seen in some island settings (Cape Verde and Zanzibar, United Republic of Tanzania), as well as in countries on the African mainland (including Eritrea, Rwanda and Zambia). In all countries, the decreases are associated with intense malaria control interventions. However, in 2009, there was evidence of an increase in malaria cases in subnational areas of three countries (Rwanda, Sao Tome and Principe, and Zambia) that had previously reported reductions, demonstrating the fragility of progress in malaria control and the need to rigorously maintain control programmes even when cases have been reduced substantially.

A recent analysis showed that from 2001 to 2010, the lives of almost three quarters of a million children across 34 malaria-endemic African countries (representing 98 per cent of the at-risk population in Africa) had been saved through vector control (insecticide-treated nets and indoor residual spraying) and intermittent preventive treatment in pregnancy. The vast majority of those lives (85 per cent) were saved from 2006 onwards, when significant funding became available. The results of that analysis suggest that if current scale-up efforts continue until 2015, the lives of an additional 1.14 million African children would be saved between 2011 and 2015. Overall, in 2010, more than one third of the 106 malarious countries documented reductions in confirmed malaria cases of more than 50 per cent compared with 2000 (11 African countries and 32 outside of Africa). Ten countries are implementing nationwide malaria elimination programmes, and eight countries are in the pre-elimination phase. Another nine countries have interrupted transmission and are at the stage of preventing the reintroduction of malaria. In 2010, Morocco and Turkmenistan were certified by WHO as free of malaria.

Resistance of parasites to antimalarial medicines and of mosquitoes to insecticides remains a major threat to achieving global malaria control. The first evidence of resistance of *Plasmodium falciparum* malaria to artemisinins was reported in western Cambodia in 2008. The multipronged containment response, which began in January 2009, is continuing, but there are worrisome data that suggest that additional foci of artemisinin resistance have emerged elsewhere in the Mekong subregion. In early 2011, WHO, together with the Roll Back Malaria Partnership, released the Global Plan for Artemisinin Resistance Containment, which was developed with input from more than 100 stakeholders. The stated objective of the Global Plan is to preserve artemisinin-based combination therapies as an effective treatment for falciparum malaria.

Disbursements to malaria-endemic countries (nearly $1.8 billion in 2010), still fall short of the estimated need in the Global Malaria Action Plan to ensure high coverage and maximal impact worldwide; the need will exceed $5 billion annually between 2010 and 2015 and $4.75 billion annually between 2020 and 2025. Achievement of the Millennium Development Goals will require not only adequate financial resources, but also the strengthening of health systems capable of delivering vector control interventions, the provision of diagnostics for the parasitologic confirmation of malaria alongside treatment with artemisinin-based combination therapies, and the development of routine surveillance systems for malaria as well as for resistance of parasites to antimalarial medicines and resistance of mosquitoes to insecticides.

I. Background and context

1. In 2009, there were an estimated 225 million cases of malaria (5th to 95th centiles, 169 million to 294 million) worldwide. The vast majority of cases (78 per cent) were in the WHO African Region, followed by the South-East Asia Region (15 per cent) and the Eastern Mediterranean Region (5 per cent). There were an estimated 781,000 deaths (5th to 95th centiles, 628 million to 968 million) in 2009, of which 91 per cent were in the African Region, followed by the South-East Asia Region (6 per cent) and the Eastern Mediterranean Region (2 per cent).

2. Despite progress, malaria remains a major killer of African children, so control of malaria will make a direct contribution to the achievement of Millennium Development Goal 4 (reducing under-5 mortality by two thirds by 2015). Malaria control will also contribute to the achievement of Millennium Development Goal 5, reducing maternal mortality. Without substantial progress in controlling malaria, which accounted for 8 per cent of deaths in children under 5 years of age globally in 2008 and 16 per cent of deaths of children under 5 years of age in Africa, Millennium Development Goal 4 will not be achieved.

3. As of 2007, the United Nations (through the Millennium Development Goals), the World Health Assembly and the Roll Back Malaria Partnership had consistent goals for intervention coverage and impact for 2010 and 2015. Those goals have evolved in recent years with the development of the Global Malaria Action Plan in 2008 to become increasingly ambitious, reflecting the substantial progress made in malaria control. The targets of the Global Malaria Action Plan were recently further revised through a consultative process. The first objective is to reduce the global number of malaria deaths to near zero by 2015, which is more ambitious than the previous targets of a 75 per cent reduction in the number of malaria deaths by 2015 (World Health Assembly 2007), and the reduction of the global number of preventable malaria deaths to near zero by 2015 (Roll Back Malaria Partnership 2008). The second objective is the reduction in the number of global malaria cases by 75 per cent by 2015 (when compared with 2000). The third is that by 2015, malaria should be eliminated in 10 additional countries (since 2008) and in the WHO European Region.

4. The intervention coverage targets in 2007 were aimed at reaching more than 80 per cent by 2010, with four key interventions: insecticide-treated nets for people at risk, appropriate antimalarial medicines for patients with probable or confirmed malaria, indoor residual spraying for targeted households at risk, and intermittent preventive treatment in pregnancy (in moderate to high-transmission settings). In accordance with the latest revision of the Global Malaria Action Plan, these targets have been made more ambitious, reflecting both changing WHO recommendations on universal diagnostic testing of suspected malaria and continued progress, and now include: universal access to case management (by 2015, 100 per cent of suspected cases receive a malaria diagnostic test and 100 per cent of confirmed cases receive treatment with appropriate and effective antimalarial drugs in public and private sectors or through community case management); universal access to and utilization of prevention measures (currently defined as every person at risk sleeping under a quality insecticide-treated net or in a space protected by indoor residual spraying and every pregnant woman at risk receiving at least one dose of intermittent preventive treatment during each of the second and third trimesters, in settings where such treatment is appropriate), and sustaining those levels; and

acceleration of the development of malaria surveillance systems (by the end of 2015, all districts have the capacity to report on a monthly basis the number of suspected malaria cases, the number of cases receiving a diagnostic test and the number of confirmed malaria cases from all public health facilities, or a consistent sample of them).

II. Policies and strategies for malaria control

5. The two most powerful and most broadly applied interventions aimed at malaria prevention through mosquito control are long-lasting insecticide-treated nets and indoor residual spraying. Because high coverage rates are needed in order to realize the full potential of either nets or spraying, WHO recommends "universal coverage" of all people at risk in areas targeted for malaria prevention. In the case of long-lasting insecticide-treated nets, this means that all people at risk, regardless of age or gender, in areas targeted for malaria prevention should be provided with nets.

6. WHO recommends that long-lasting insecticide-treated nets be either delivered free of charge or made available at highly subsidized prices. Cost should not be a barrier to making them available to all people at risk for malaria, especially those at greatest risk for adverse outcomes, such as young children and pregnant women.

7. Universal coverage with long-lasting insecticide-treated nets is best achieved and maintained by combining distribution through initial rapid coverage with periodic mass campaigns supplemented by routine delivery to pregnant women through antenatal services and to infants at immunization clinics.

8. Only nets recommended by the WHO Pesticide Evaluation Scheme should be procured by national malaria control programmes and partners for malaria control. Such nets are designed to maintain their biological efficacy against vector mosquitoes for at least three years in the field under recommended conditions of use, obviating the need for regular insecticide treatment. There is a pressing need to move towards basing procurement decisions not on the lowest unit cost per net, but the lowest cost per life year covered by a long-lasting insecticide-treated net, taking into account the durability of the net. This approach may result in improved effectiveness of the interventions, as well as improved efficiencies and cost savings as a result of reduced delivery costs. Such a shift requires the adoption of routine monitoring of the durability of the nets under field conditions, as is recommended by WHO (World Health Organization 2011: *Guidelines for monitoring the durability of long-lasting insecticidal mosquito nets under operational conditions*). In addition, interim guidance is being prepared for endemic countries and donor agencies to inform procurement decisions and improve value for money, and is expected to be ready in early 2012.

9. Twelve insecticides belonging to four chemical classes are currently recommended by the Scheme for indoor residual spraying. Dichlorodiphenyltrichloroethane (DDT) has comparatively long residual efficacy (more than six months) against malaria vectors. Under the Stockholm Convention on Persistent Organic Pollutants, countries can continue to use DDT for indoor residual spraying, provided that the guidelines and recommendations of WHO are followed.

10. Current methods of malaria control are highly dependent on a single class of insecticides, the pyrethroids, which are the most commonly used compounds for

indoor residual spraying and the only insecticide class used for treated nets. The widespread use of a single class of insecticide increases the risk that mosquitoes will develop resistance, which could rapidly lead to a major public health problem, particularly in Africa, where chemical vector control is being deployed with unprecedented levels of coverage and where the burden of malaria is greatest. Monitoring and managing resistance to the insecticides used in both long-lasting insecticide-treated nets and indoor residual spraying are vital to ensure that the appropriate mix of malaria vector control interventions is being used. Recent recommendations from WHO call for programmes to avoid the practice of spraying the same insecticide (or class of insecticides) repeatedly year after year; instead, insecticides with different modes of action should be sprayed alternately, in rotation. This and other recommendations can be found in *The technical basis of coordinated action against insecticide resistance: preserving the effectiveness of modern malaria vector control* (WHO, 2011). The World Health Assembly has called on WHO to develop a global plan for insecticide resistance management in malaria vectors, which is expected to be released in early 2012.

11. Early and effective treatment of malaria reduces morbidity, prevents death and reduces the reservoir of infection, leading to successful malaria control. Updated *WHO Guidelines for the Treatment of Malaria* were released in 2010.

12. For all patients with suspected malaria, prompt parasitological confirmation through microscopy or a rapid diagnostic test is recommended before treatment is started. Treatment based solely on clinical suspicion should be considered only when a parasitological diagnosis is not accessible. Parasitological confirmation of malaria before treatment is increasingly important because as transmission falls, so does the proportion of fevers that are attributable to malaria. By treating all cases of fever as malaria, not only are artemisinin-based combination therapies overused, but also appropriate care for people with other causes of fever is not provided. Expansion of the use of rapid diagnostic tests will help to reduce the overdiagnosis of malaria and overuse of antimalarial medicines. In Senegal, following the introduction of rapid diagnostic tests in 2007, malaria diagnostic testing rates rose rapidly from 4 per cent to 86 per cent (by 2009); the prescription of artemisinin-based combination therapy dropped throughout this period from 73 per cent of malaria-like febrile illness to 32 per cent, reaching close equivalence to confirmed malaria (30 per cent of 585,000 suspected fever cases). More than 500,000 courses of inappropriate artemisinin-based combination therapy prescription were averted.

13. Confirmed cases of *Plasmodium falciparum* malaria without complications should be treated with an artemisinin-based combination therapy, and cases of *Plasmodium vivax* should be treated with chloroquine in areas where it is effective, or with an appropriate artemisinin-based combination therapy in areas where the resistance of *Plasmodium vivax* to chloroquine has been documented. Treatment of *Plasmodium vivax* should be combined with 14 days of primaquine to prevent relapse, after confirming that the patient does not have glucose-6-phosphate dehydrogenase deficiency. A single dose of primaquine may be added to an artemisinin-based combination therapy for treatment of *Plasmodium falciparum* malaria as an anti-gametocyte medicine, particularly as a component of a pre-elimination or elimination programme, provided the risk of haemolysis in patients with glucose-6-phosphate dehydrogenase deficiency has been considered.

14. Artemisinin-based combination therapies not only are efficacious, but also help to prevent the emergence and spread of drug-resistant Plasmodium. Five such therapies are currently recommended for use because of their safety and efficacy: artemether-lumefantrine, artesunate-amodiaquine, artesunate-mefloquine, artesunate-sulfadoxine-pyrimethamine and dihydroartemisinin-piperaquine (which has recently received regulatory approval from the European Medicines Agency). The choice of the therapy should be based on the efficacy of the combination in the country or area of intended use. Artemisinin-based fixed-dose combinations are strongly preferable to loose individual medicines that are co-blistered or co-dispensed.

15. In November 2010, the results of a trial known as Aquamat proved that parenteral artesunate is superior to quinine for the treatment of severe malaria, including among children living in high malaria transmission areas in Africa. Based on these results, WHO has updated the guidelines for the treatment of malaria, and now recommends parenteral artesunate (intravenous or intramuscular), as first choice treatment for severe malaria in all endemic areas. Accelerated action is needed at the country level to ensure that national policies are updated accordingly. In November 2010, WHO pre-qualified Artesunate IV, manufactured by Guilin Pharmaceutical in China. Therefore, this medicine can now be procured by multiple international funding agencies, including the Global Fund, making possible a large increase in procurement and access to this important and life-saving medicine.

16. Intermittent preventive treatment in pregnancy with sulfadoxine pyrimethamine, given two to three times during the second and third trimesters of pregnancy during antenatal care visits, is recommended for pregnant women in areas of high transmission. Intermittent preventive treatment in infants, using a single dose of sulfadoxine pyrimethamine administered three times during the first year of life at routine expanded programme on immunization visits, is recommended for areas of high transmission where sulfadoxine pyrimethamine still remains effective as a preventive medicine.

17. Parasite resistance has rendered previous antimalarial medicines ineffective in most parts of the world, threatening malaria control. The highly effective artemisinin derivatives and their partner drugs are vulnerable to the same risk. WHO recommends that oral artemisinin-based monotherapies not be used for the treatment of uncomplicated malaria and that they be withdrawn from the market and replaced with artemisinin-based combination therapies.

III. Financing of malaria control

18. Advocacy efforts at the global, regional and national levels over the course of the past 10 years spurred an upsurge in terms of political and financial commitment to malaria control efforts.

19. Financial commitments to malaria control on the part of external agencies have increased dramatically from approximately $0.3 billion per year in 2003 to $1.8 billion in 2010. However, commitments appear to have stagnated in 2009 and 2010, at $1.8 billion. While commitments are critical, it is the international disbursements for malaria to malaria-endemic countries that determine progress. These disbursements increased from $35 million in 2000 to $200 million in 2004 to more than $1.5 billion in 2009, a fortyfold increase.

20. The Global Fund to Fight AIDS, Tuberculosis and Malaria accounted for $2.8 billion, or more than 60 per cent, of all external malaria-control funds disbursed to malaria-endemic countries between 2000 and 2009. The United States Agency for International Development, including the President's Malaria Initiative, was second to the Global Fund as a source of funds from 2000 to 2009, increasing its malaria funding by a factor of 30 from $10 million in 2000 to $300 million in 2008; the World Bank disbursed $54.2 million, and the combined bilateral donor countries (not including the United States) and other multilateral donors disbursed approximately $120 million.

21. The number of countries receiving external assistance for malaria increased from 29 in 2000 to 77 in 2008 (out of a total of 106 malaria-endemic countries in 2010). The highest per capita expenditure continued to be seen in countries with smaller populations at risk. There is an approximate difference of ninetyfold between the per-person-at-risk funding level in sub-Saharan Africa; Côte d'Ivoire received $0.57 per person at risk, and Sao Tome and Principe received $50.93 per person at risk over the seven-year period from 2003 to 2009. External financing appears to be concentrated on programme activities, particularly the procurement of insecticide-treated nets, antimalarial medicines and indoor residual spraying. A larger proportion of national government financing is directed towards human resources, although significant amounts are also spent on antimalarial medicines and spraying.

22. An analysis of the malaria prevention and control programmes of private sector efforts by three companies in Zambia (Mopani Copper Mines, Konkola Copper Mines and Zambia Sugar) showed that among the 157,000 individuals (including 33,000 employees, their dependants and surrounding members of the community) protected over the period from 2000 to 2009, annual malaria cases decreased 94 per cent, annual malaria-related workdays lost decreased 94 per cent and malaria-related spending at company clinics decreased 76 per cent. A total of 108,000 malaria episodes were averted, and more than 300 lives were saved. Other public-private partnerships — AngloGold Ashanti in Ghana, Marathon Oil in Equatorial Guinea and BHP Billiton in Mozambique — all reduced company health-care costs and workdays lost to malaria. These results indicate a minimum return on malaria control investment of 28 per cent, providing unprecedented evidence that businesses can and should be involved in malaria control efforts.

23. Information on domestic financing for malaria is less complete and likely contributed to an overall underestimate of the total financial resources available for malaria control. Nonetheless, domestic spending on malaria control appears to have risen in all WHO regions in the countries that report financial data. Large increases in donor financing do not appear to have resulted in an overall reduction in the amount of domestic financing, although countries that had reduced their spending had received more external financing than those that increased their domestic spending.

24. Government financing frequently covers the fixed costs of operating malaria programmes, including human resources and programme management (including information systems, planning workshops, supervision, etc.). The expenditures of these external agencies, such as the Global Fund and President's Malaria Initiative, are more often directed to the financing of variable costs, such as the provision of commodities and their distribution.

25. While the total funds available for malaria control have increased to unprecedented levels they are still lower than the annual amount estimated in the

Global Malaria Action Plan — between $5.0 billion and $6.2 billion per year between 2009 and 2015 — to successfully control malaria.

IV. Programme implementation: vector control

26. In 2009, 23 countries in the African Region and 42 outside it had adopted the WHO recommendation that mosquito nets be provided for all age groups at risk for malaria, not just women and children; this represents an increase of 13 countries since 2008. A total of 83 countries, of which 39 are in the African Region, distribute insecticide-treated nets free of charge.

27. According to data provided by the Alliance for Malaria Prevention of the Roll Back Malaria Partnership, the number of long-lasting insecticide-treated nets delivered to sub-Saharan African countries rose from 5.6 million per year in 2004 to 88.5 million per year in 2009. In 2010 a further 141 million insecticide-treated nets were delivered. Thus, in less than three years between 2008 and 2010, a cumulative total of 289 million insecticide-treated nets were supplied and delivered to sub-Saharan Africa, enough to cover 76 per cent of the 765 million persons at risk (assuming two people sleeping under each net).

28. More than 50 per cent of the insecticide-treated nets provided between 2008 and 2010 were delivered to seven countries: the Democratic Republic of the Congo, Ethiopia, Kenya, Nigeria, the Sudan, Uganda and the United Republic of Tanzania, which comprise 56 per cent of the population at risk in sub-Saharan Africa.

29. The percentage of children using insecticide-treated nets is still below the World Healthy Assembly target of 80 per cent, partly because up to the end of 2009, insecticide-treated net ownership remained low in some parts of the largest African countries. Resources for further scale-up have subsequently been made available, with more than 140 million nets delivered in 2010, including at least 52 million to the three most populous countries in Africa (the Democratic Republic of the Congo, Ethiopia and Nigeria).

30. Household survey data for 2007-2009 indicate that 10 countries (Equatorial Guinea, Ethiopia, Gabon, Mali, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, Togo and Zambia) had reached a household ownership rate of insecticide-treated nets of more than 50 per cent. The proportion of children sleeping under a net in 2010 was estimated to be 35 per cent, compared with 17 per cent in 2007. The low rates of use reported in some surveys are due primarily to a lack of sufficient nets to cover all household members; however, a very high proportion of available insecticide-treated nets (80 per cent) is used.

31. A model-based estimate showed that 42 per cent of African households owned at least one insecticide-treated net, and 35 per cent of children under 5 years of age slept under such a net in 2010. Household ownership of insecticide-treated nets was estimated in this model to have reached 50 per cent or higher in 19 African countries in 2010.

32. A consistent pattern emerges across countries showing that persons aged 5-19 years are least likely to use an insecticide-treated net compared with those in the younger and older age groups, which is cause for concern, as such persons are at significant risk of malaria, especially as its transmission falls. Women are slightly more likely to sleep under an insecticide-treated net than men (ratio

women:men = 1.1) owing partly to the fact that pregnant women are more likely to sleep under a net. There are no differences in usage rates between female and male children under 5 years of age.

33. Indoor residual spraying programmes have expanded considerably in recent years. In 2009, 71 countries, 32 of which are in Africa, reported recommending indoor residual spraying. A total of 168 million persons were protected by indoor residual spraying in 2009; the number of people protected by spraying in the African Region rose from 10 million in 2005 to 73 million in 2009, corresponding to the protection of 10 per cent of the at-risk population. Twelve countries protected more than 10 per cent of their populations at risk in 2009: Sao Tome and Principe (83 per cent), South Africa (80 per cent), Equatorial Guinea (79 per cent), Ethiopia (50 per cent), Gambia (47 per cent), Zambia (43 per cent), Zimbabwe (41 per cent), Madagascar (34 per cent), Mozambique (36 per cent), Namibia (31 per cent), Botswana (18 per cent) and Rwanda (14 per cent).

V. Programme implementation: diagnosis

34. The percentage of reported suspected malaria cases receiving a parasitological test has increased between 2005 and 2009, particularly in the African Region (from 26 per cent to 35 per cent), the Eastern Mediterranean Region (47 per cent to 68 per cent) and South-East Asia Region, excluding India (from 58 per cent to 95 per cent). Low rates persist in the majority of African countries: in 21 out of 42 countries, which reported on testing, the percentage of cases tested was less than 20 per cent. However, major scale-up efforts are currently under way following the 2010 WHO recommendation for universal access to diagnostic testing of suspected malaria cases.

35. The number of rapid diagnostic tests delivered increased rapidly in 2009 from less than 200,000 in 2005 to about 30 million in 2009, with most rapid diagnostic tests (44 per cent) being used in the African Region, followed by the South-East Asia Region (41 per cent) and the Eastern Mediterranean Region (11 per cent). However, these totals are likely to underestimate the quantity of rapid diagnostic tests distributed, as only 21 of the 43 endemic countries in the African Region reported such data in 2009.

36. A wide range of brands of rapid diagnostic tests is available on the market, and products differ in their performance. In addition, test performance is affected by extremes of heat and humidity, conditions that frequently prevail in malaria-endemic settings. In order to ensure the high-quality rapid diagnostic tests, countries are advised to procure products that have demonstrated good performance in the WHO Rapid Diagnostic Test Evaluation Programme. The programme, which was launched in 2006 in collaboration with the Foundation for Innovative New Diagnostics and the United States Centers for Disease Control and Prevention, assesses and reports on the performance of rapid diagnostic test products and serves as a guide for countries and procurement agencies in selecting high-quality tests. A third round of performance test results is now available. An unprecedented number of product submission requests were received, and 50 products were tested after limiting submission to three per manufacturer; of those products, 23 were resubmissions from previous rounds. A major improvement in quality was observed in the resubmitted products, with an increase in median parasite detection score at low

parasite densities from 63 per cent to 84 per cent for *Plasmodium falciparum* and 30 per cent to 63 per cent for *Plasmodium vivax*, demonstrating that manufacturers are being guided by the testing process to improve the quality of their products. Since the performance of various production lots of individual products often varies over time, it is recommended that all lots of procured products be checked for quality through lot testing prior to large-scale deployment in the field and that a process for the monitoring of rapid diagnostic test performance in the field be put in place. The Rapid Diagnostic Test Evaluation Programme provides the service of lot testing of rapid diagnostic tests at several regional centres.

VI. Programme implementation: treatment

37. By 2009, 77 of 86 *Plasmodium falciparum* malaria-endemic countries and territories had adopted artemisinin-based combination therapies for use as part of their national drug policies.

38. The use of oral artemisinin-based monotherapies threatens the therapeutic life of artemisinin-based combination therapies by fostering the spread of resistance. Despite the appeal made by WHO for a halt in the use of these medicines (World Health Assembly resolution 60.18, endorsed by all WHO member States in May 2007), production continues, and many countries have not yet withdrawn them from their markets. Since the appeal of WHO, 35 countries have withdrawn marketing authorization for oral artemisinin-based monotherapy. Out of 80 companies involved in the production and marketing of these medicines, a total of 46 have de-listed oral artemisinin-based monotherapy from their product catalogues. However, there is more work to be done, as 34 companies, mainly those targeting the private-sector markets of malaria-endemic countries, are still actively marketing monotherapies. Greater assistance to national drug regulatory authorities is required to phase out oral artemisinin-based monotherapies from the market.

39. The procurement of artemisinin-based combination therapies for the public sector continues to increase, rising from more than 76 million treatment courses in 2006 to 158 million in 2009.

40. The number of artemisinin-based combination therapies distributed by national malaria control programmes appears to have increased between 2007 and 2009, but reporting by country is incomplete. Nevertheless, country reports indicate that by the end of 2009, 11 African countries were providing sufficient courses of artemisinin-based combination therapies to cover more than 100 per cent of malaria cases seen in the public sector; a further eight African countries delivered sufficient courses to treat 50-100 per cent of cases. These figures represent a substantial increase since 2005, when only five countries were providing sufficient courses of artemisinin-based combination therapy to cover more than 50 per cent of patients treated in the public sector. However, the number of artemisinin-based combination therapy courses distributed by national malaria control programmes in the African Region in 2009 exceeded the total number of diagnostic tests carried out (microscopy and rapid diagnostic tests) by a factor of 2.4, indicating that many patients are still receiving artemisinin-based combination therapies without confirmatory diagnosis.

41. By combining household survey data with health facility data, it can be estimated that, on average, 65 per cent of treatment needs are fulfilled for patients

attending public health facilities. In the private sector, febrile patients are 25 per cent less likely to receive an antimalarial than those visiting public sector facilities, while those that stay at home are 60 per cent less likely.

42. The Affordable Medicines Facility for Malaria, an innovative financing mechanism designed to expand access to the most effective malaria treatments, has launched a pilot to increase access to artemisinin-based combination therapies in the private sector and to displace cheaper but ineffective medicines and monotherapies that promote drug resistance. Managed by the Global Fund, this programme is being piloted in eight countries and will operate for approximately 24 months before being reviewed through an independent evaluation to determine whether to expand, accelerate, modify or suspend the Facility. The Global Fund board is expected to make this decision in 2012.

43. The first evidence of *Plasmodium falciparum* resistance to artemisinin in western Cambodia was published in 2008. A multipronged project to contain the spread of artemisinin resistance was implemented on the Cambodia-Thailand border that began in January 2009 is continuing. However, there are concerning data to suggest that foci of artemisinin-resistant *Plasmodium falciparum* may have emerged in other sites in the Mekong subregion. In response to this grave threat to global malaria control efforts, WHO worked with more than 100 stakeholders across the Roll Back Malaria Partnership to develop the Global Plan for Artemisinin Resistance Containment. The plan, launched by the WHO Director-General in January 2011, calls on all partners to collaborate in order to stop the spread of resistant parasites; increase monitoring and surveillance for artemisinin resistance; improve access to malaria diagnostic testing and rational treatment with artemisinin-based combination therapies; invest in artemisinin resistance-related research; and motivate action and mobilize resources.

VII. Preventive treatment

44. A total of 33 of 43 endemic countries in the African Region, as well as two countries in the Eastern Mediterranean Region (Somalia and Sudan) and one in the Western Pacific Region (Papua New Guinea), had adopted intermittent preventive treatment for pregnant women as a national policy by the end of 2009. Data on intermittent preventive treatment for pregnant women from surveys in 2007-2008 were available for eight countries in Africa, representing a combined population of 270 million. In 2007-2008, the percentage of women who received two doses of treatment during pregnancy ranged from 2.4 per cent in Angola to 62 per cent in Zambia; the weighted average remained low, at 12 per cent, owing to low coverage rates in the largest countries. Data reported by national malaria control programmes in 22 high-burden countries in the African Region indicate that the percentage of women attending antenatal clinics who received the second dose of intermittent preventive treatment was 55 per cent.

VIII. Impact of control programmes in the World Health Organization African Region

45. A total of 11 countries and one area in the African Region showed a reduction of more than 50 per cent in either confirmed malaria cases or malaria admissions

and deaths in recent years (Algeria, Botswana, Cape Verde, Eritrea, Madagascar, Namibia, Rwanda, Sao Tome and Principe, South Africa, Swaziland, Zambia, and Zanzibar, United Republic of Tanzania). In all countries, the decreases are associated with intensive scale-up of malaria control interventions. As a result of these significant reductions in malaria-related disease burdens, progress towards the halving of under-five mortality (Millennium Development Goal 4) has been accelerated.

46. Similar impacts may have occurred in other high-burden African countries, but changes in morbidity and mortality have been difficult to routinely detect because disease surveillance systems are not sufficiently developed. Based on malaria prevention scale-up (intermittent preventive treatment for pregnant women, insecticide-treated nets, indoor residual spraying) in 34 African countries over the past decade, it is estimated that more than 735,000 lives have been saved between 2000 and 2010, most of them since 2006.

47. In 2009, there was evidence of an increase in malaria cases in three countries that had previously reported reductions (Rwanda, Sao Tome and Principe and Zambia). The reasons for these resurgences are not known with certainty, but they highlight the fragility of progress in malaria control and the need to rigorously maintain control programmes even when cases have been reduced substantially.

48. Four out of five low transmission countries in southern Africa (Botswana, Namibia, South Africa and Swaziland) showed decreases of greater than 50 per cent in the number of confirmed malaria cases between 2000 and 2009. Four of these countries (Botswana, Namibia, South Africa and Swaziland) also reported decreases in the number of deaths from malaria. Cape Verde showed sustained decreases from 2000 to 2008, enabling it to enter the pre-elimination phase of malaria control. It recorded a rise in cases in 2009, which may be due to increased case detection efforts. Each of these countries shows evidence of large-scale malaria programme activity.

IX. Impact of control programmes in other World Health Organization Regions

49. In the other WHO Regions, the number of reported cases of confirmed malaria decreased by more than 50 per cent in 32 of the 56 malaria-endemic countries between 2000 and 2009, and downward trends of 25-30 per cent were seen in eight other countries. In 2009, the European Region reported no locally acquired cases of *Plasmodium falciparum* malaria for the first time. The number of cases fell the least in countries with the highest incidence rates, indicating that greater attention should be given to such countries, which harbour most of the malaria burden outside Africa.

50. The number of cases reported in the region of the Americas decreased from 1.18 million in 2000 to 526,000 in 2009. Four countries (Brazil, Colombia, Haiti and Peru) accounted for 90 per cent of the cases in 2009. Reductions of more than 50 per cent were reported in 11 countries (Argentina, Belize, Bolivia (Plurinational State of), Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Paraguay and Suriname). Four of the countries are in the elimination or pre-elimination stage, and actively follow up suspected cases (Argentina, El Salvador, Mexico and

Paraguay), while four others show evidence of control activities being implemented extensively in populations at risk of malaria (Ecuador, Guatemala, Nicaragua and Suriname). Brazil has greatly extended the availability of diagnosis and treatment through a network of more than 40,000 health workers who reach individual households. Three countries (Dominican Republic, Haiti and Venezuela (Bolivarian Republic of)) reported increased numbers of cases between 2000 and 2009, with the highest increase seen in Haiti (three times more cases in 2009 compared with 2000).

51. Reductions of more than 50 per cent in the number of reported cases between 2000 and 2009 were seen in five countries in the South-East Asia Region (Bhutan, the Democratic People's Republic of Korea, Nepal, Sri Lanka and Thailand). The number of confirmed cases in India was 23 per cent lower in 2009 than in 2000. There was evidence of wide-scale implementation of antimalarial interventions in three countries that showed decreases in the number of cases (Bhutan, Sri Lanka and Thailand), although intervention coverage has been less than 50 per cent in recent years in Sri Lanka and Thailand. Two countries in the pre-elimination stage actively follow up all suspected cases (Democratic People's Republic of Korea and Sri Lanka). The scale of preventive interventions appears to be small in India and Nepal, with less than 30 per cent of the population at high risk covered. The remaining malaria-endemic countries reported no change or an increase in cases (Bangladesh, Indonesia, Myanmar and Timor-Leste), and the scale of control activities appeared to be small in relation to the total population at risk.

52. The number of reported malaria cases in the European Region has been reduced substantially, from 32,385 in 2000 to 285 in 2009. Intensive control activities are implemented throughout the region. Indoor residual spraying is the primary means of vector control, supplemented by the use of the larvivorous Gambusia fish in rice-growing areas, passive and active case detection and inter-country collaboration in affected border areas. In 2005, all nine malaria-affected countries in the European Region endorsed the Tashkent Declaration, the goals of which are to interrupt malaria transmission by 2015 and to eliminate the disease within the Region. No indigenous *Plasmodium falciparum* cases were reported in 2009 for the first time since the resurgence of malaria in the early 1990s. Four countries in the Eastern Mediterranean Region have seen reductions in malaria cases of more than 50 per cent between 2000 and 2009 (Afghanistan, Iran (Islamic Republic of), Iraq and Saudi Arabia), the last three of which have shown evidence of a sustained decrease in the number of cases associated with wide-scale implementation of malaria control activities and are classified as being in the elimination or pre-elimination stage. Other countries in the Region have not registered consistent decreases in the number of cases (Djibouti, Pakistan, Somalia, the Sudan and Yemen), although the Sudan has extended the coverage of malaria preventive activities to more than 50 per cent of the at-risk population.

53. In the Western Pacific Region, five countries reported decreases in the numbers of confirmed cases of more than 50 per cent between 2000 and 2009 (China, the Lao People's Democratic Republic, the Republic of Korea, Solomon Islands and Viet Nam). There is evidence of widespread implementation of malaria control activities in all these countries, either through vector control or enhanced case management. Three countries reported decreases of 25-50 per cent (Malaysia, the Philippines and Vanuatu); there is widespread coverage of vector control interventions in Malaysia and Vanuatu. In both Cambodia and Papua New Guinea,

there was little change in confirmed cases, although Cambodia has reported a reduction in malaria deaths from 608 in 2000 to 279 in 2009 (54 per cent decrease).

X. Elimination

54. WHO encourages countries in areas of low, unstable transmission to proceed to malaria elimination (interrupting transmission).[1] The conditions that are prerequisites for achieving and sustaining malaria elimination in these settings include the presence of a health system providing nationwide coverage of quality-controlled services, including surveillance. In areas of high, stable transmission with unrelentingly high vectorial capacities, such as many parts of tropical Africa, achieving and sustaining a malaria-free status is improbable, given the currently available malaria control tools.

55. In 2009, there were eight countries (Argentina, El Salvador, Paraguay, Iran (Islamic Republic of), Malaysia, Mexico, the Democratic Republic of Korea and Sri Lanka) in the pre-elimination stage of malaria control. A ninth country, Cape Verde, was added in 2010. Ten countries (Algeria, Azerbaijan, Georgia, Iraq, Kyrgyzstan, Republic of Korea, Saudi Arabia, Tajikistan, Turkey and Uzbekistan) are implementing elimination programmes nationwide. A further seven countries (Armenia, the Bahamas, Egypt, Jamaica, Oman, the Russian Federation and the Syrian Arab Republic) are in the phase of preventing introduction of malaria.

56. In May 2010, Morocco became the second country in recent history to be certified by WHO as having achieved malaria elimination (the United Arab Emirates was certified as malaria free by WHO in January 2007). Morocco reported its last case of indigenous *Plasmodium vivax* malaria transmission in 2004. In October 2010, Turkmenistan was added to the *WHO Official Register* of areas where malaria elimination has been achieved. The last case was also registered in 2004. Armenia has initiated the process for certification of malaria elimination.

XI. Summary and recommendations

57. **Progress is being made towards achieving the goals for malaria control set forth by the World Health Assembly, the Roll Back Malaria Partnership and the Millennium Development Goals.**

58. **International funding for malaria control has risen steeply in the past decade. Disbursements reached their highest ever levels in 2009 at $1.5 billion, but new commitments for malaria control appear to have stagnated in 2009 and 2010 at $1.8 billion. Countries with smaller at-risk populations continue to**

[1] Malaria elimination: the interruption of local mosquito-borne malaria transmission; reduction to zero of the incidence of infection caused by human malaria parasites in a defined geographical area as a result of deliberate efforts; continued measures to prevent the re-establishment of transmission are required. Certification of malaria elimination: can be granted by WHO after it has been proved beyond reasonable doubt that the chain of local human malaria transmission by Anopheles mosquitoes has been fully interrupted in an entire country for at least three consecutive years. Malaria eradication: permanent reduction to zero of the worldwide incidence of infection caused by a specific agent; applies to a particular malaria parasite species. Intervention measures are no longer needed once eradication has been achieved.

receive more funding per person at risk than more populous countries. The amounts committed to malaria, while substantial, still fall short of the resources required for malaria control, estimated at more than $6 billion for the year 2010.

59. The increased financing has resulted in tremendous progress in increasing access to insecticide-treated mosquito nets in the past three years. Between 2008 and the end of 2010, approximately 289 million long-lasting insecticide-treated nets were delivered to sub-Saharan Africa, enough to cover 76 per cent of the 765 million persons at risk of malaria. It is estimated that 42 per cent of households in Africa owned at least one insecticide-treated net in mid-2010, and that 35 per cent of children slept under such a net. The percentage of children using insecticide-treated nets is still below the World Health Assembly target of 80 per cent, partly because up to the end of 2009, ownership of the nets remained low in some of the largest African countries. Low rates of usage reported in some surveys are owing primarily to a lack of sufficient nets to cover all household members; household survey results suggest that most of the available nets (80 per cent) are being used.

60. While the rapid scale-up of distribution of long-lasting insecticide-treated nets in Africa represents an enormous public health achievement, it also represents a formidable challenge for the future in ensuring that the high levels of coverage are maintained. The lifespan of a long-lasting net is currently estimated to be three years. Nets delivered in 2006 and 2007 are therefore already due for replacement, and those delivered between 2008 and 2010 soon will be. It is a public health imperative to replace these nets as a life-saving intervention; failure to do so could lead to a resurgence of malaria cases and deaths. It is important to move towards procuring long-lasting nets based on the lowest cost-per-life year covered rather than the lowest unit cost.

61. Indoor residual spraying programmes have also expanded considerably in recent years, with the number of people protected in sub-Saharan Africa increasing from 13 million in 2005 to 75 million in 2009, corresponding to protection for approximately 10 per cent of the at-risk population in 2009.

62. WHO now recommends that all cases of suspected malaria be confirmed with a diagnostic test prior to treatment. As the incidence of malaria decreases through much of sub-Saharan Africa, the need to differentiate malaria from non-malarial fevers becomes more pressing. The proportion of reported cases in Africa confirmed with a diagnostic test has risen substantially from less than 5 per cent at the beginning of the decade to approximately 35 per cent in 2009, but low rates persist in the majority of African countries and in a minority of countries in other regions. A small number of countries have shown that it is possible to rapidly scale up the availability of malaria diagnostic testing on a national scale, provided that attention is given to adequate preparation, training, monitoring, supervision and quality control. Such experiences have been linked with large savings in the use of artemisinin-based combination therapies and with improved malaria surveillance.

63. Information from manufacturers indicates that the number of artemisinin-based combination therapies procured has increased in every year since 2005. By the end of 2009, 11 African countries were providing sufficient courses of artemisinin-based combination therapies to cover more than 100 per

cent of malaria cases seen in the public sector; a further eight African countries delivered sufficient courses to treat 50-100 per cent of cases. These figures represent a substantial increase since 2005, when only five countries were providing sufficient courses of artemisinin-based combination therapy to cover more than 50 per cent of patients treated in the public sector. However, information on access to treatment is generally incomplete, particularly for the significant proportion of patients treated in the private sector.

64. **A total of 11 countries and one area in the WHO African Region showed a reduction of more than 50 per cent in either confirmed malaria cases or malaria admissions and deaths in recent years. A decrease of more than 50 per cent in the number of confirmed cases of malaria between 2000 and 2009 was found in 32 of the 56 malaria-endemic countries outside Africa, while downward trends of 25-50 per cent were seen in eight other countries. Morocco and Turkmenistan were certified by the Director-General of WHO in 2009 as having eliminated malaria. In 2009, the European Region reported no cases of *Plasmodium falciparum* malaria for the first time.**

65. **It is estimated that the number of cases of malaria rose from 233 million in 2000 to 244 million in 2005 but decreased to 225 million in 2009. The number of deaths from malaria is estimated to have decreased from 985,000 in 2000 to 781,000 in 2009. Decreases in the malaria burden have been observed in all WHO Regions, with the largest proportional decreases noted in the European Region, followed by the Region of the Americas. The largest absolute decreases in deaths were observed in Africa.**

66. **Going forward, it is urgent that all countries and development partners work to maintain malaria high on the political and development agendas, to advocate strongly for adequate and predictable long-term financing for malaria control, and to sustain national financial commitments for malaria control in order to accelerate implementation of the policies and strategies recommended by WHO, thereby achieving World Health Assembly targets for malaria, the health-related Millennium Development Goals, as well as the ambitious objectives of the Roll Back Malaria Partnership, notably near-zero malaria deaths by the end of 2015.**

67. **It is essential that countries undertake regular and comprehensive reviews of malaria programmes as an essential step in developing strategic and operational plans for achieving and maintaining universal access to and coverage of malaria interventions.**

68. **Recommended vector-control interventions should be provided and maintained for all people at risk, particularly through: (a) replacement and continuous provision of long-lasting insecticide-treated bednets and targeted communication about their usage; and/or (b) regular application of indoor residual spraying with insecticides.**

69. **Prompt diagnostic testing of all suspected malaria cases should be provided, along with effective treatment with artemisinin-based combination therapy for patients with confirmed *falciparum* malaria, in both the public and private sectors, including the community level. The expansion of diagnostic services can be used as an opportunity to strengthen malaria surveillance.**

70. **In order to sustain the advances in malaria control, it is essential to take immediate action to combat resistance to artemisinin-based medicines, by implementing the recommendations in the Global Plan for Artemisinin Resistance Containment, including strengthening regulatory services in the public and private sectors, working to halt the use of oral artemisinin-based monotherapies and substandard medicines not meeting WHO prequalification standards or strict national regulatory authority standards, introducing quality-assurance mechanisms, and improving supply-chain management for all malaria commodities and services.**

71. **It is also vital to combat resistance to insecticides by adopting best practices, such as: rotation of insecticides used for indoor residual spraying; and using insecticides approved for indoor residual spraying from insecticide classes other than pyrethroids (and compounds sharing cross-resistance with pyrethroids) in areas where usage of insecticide-treated bednets is high. These recommendations will be elaborated in greater detail as part of the global plan for insecticide resistance management in malaria vectors, which is currently under development.**

72. **The expansion of interventions for malaria prevention and control can be used as an entry point for strengthening health systems, including laboratory services, maternal and child health services at peripheral health facilities, integrated management of illnesses at the community level, and timely and accurate surveillance.**

73. **At the heart of all malaria control programmes are people. In order to maintain core national competencies for malaria control, a strong cadre of malaria experts, including entomologists, needs to be maintained at all levels of the health-care system.**

74. **Malaria remains a leading killer of children under 5 years of age. Success in this fight is crucial to improving the health of women and children around the world, especially in Africa, and in generating progress towards the health-related Millennium Development Goals and towards the goals articulated in the Global Strategy for Women's and Children's Health.**